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PLANT LIFE ON MOUNT MAQUILING[1]

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WITH FIVE PLATES AND THREE TEXT FIGURES

Mount Maquiling rises as an isolated cone sixty-four kilometers south-east of Manila on the boundary of the provinces of Laguna and Batangas. Its sides are channelled by deep gullies, but, except for small springs which all but disappear in the dry season, there are few permanent streams above a level of about four hundred meters. The upper part of the mountain is generally in the clouds, the highest peak being 1128 meters above sea level. Around the base hot springs are common as is the case with many almost extinct volcanoes, and the most interesting of these is Natugnos, a collection of boiling mud springs which occurs at a greater elevation than the others—about 300 meters. Occasionally mud is thrown from the smaller fumaroles to a height of a meter or so, but in the largest spring, which is about fifteen meters in diameter, the mud boils quietly and steadily. New springs may be started by poking a hole through the thin hardened crust with a stick. The steam rising from this collection of springs has produced an extremely luxuriant local vegetation. The species are for the most part those commonly occurring in the forest near by, but the size and glossiness of the leaves are remarkable. The soil conditions around the mud springs are similar to those elsewhere at the same altitude, and this local development illustrates well the effect of the moist heat.

From the top of the mountain a number of other isolated cones can be seen, the highest being Mount Banahao. To the southwest, set in the middle of Lake Bombon, is Taal Volcano which exploded in 1911 destroying 1400 lives. This cone is now quiescent and the vegetation, very little of which survived the eruption, is beginning to re-invade its slopes. In this, Taal is a marked contrast to Maquiling, the flora of which has reached its full development. One of the main species on Taal is the *talahib* (*Saccharum spontaneum*) a coarse grass about three meters in height. A few trees have established themselves, some of them having sprouted from stumps not killed in 1911. The presence of the guava can be attributed to the cattle that graze on the island. Along the tracks are numerous seedlings growing from manure. The soil is not nearly covered, but in the course of time small trees and finally tall forest trees will appear. The present flora of Taal is transitional. Somewhat similar at first sight is the vege-

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tation on Talim, an island in Laguna de Bay, which can be seen about 24 kilometers to the north from Maquiling. Here the vegetation consists largely of such tall grasses as *Imperata cylindrica* (*cogon*) and *Saccharum spontaneum* (*talahib*) mingled with small trees, such as *Macaranga* and *Psidium*. This, however, is not a transition between bare barren soil and the final plant formation, but represents the first stages of revegetation of an area artificially denuded of its plants. Repeated burning is responsible for the type of vegetation in this case. These species are quickly killed by competition, and produce only temporary formations, unless assisted by fire in their fight against the forest trees. The type of flora on Taal therefore resembles that of Talim in that both are phases only. On Taal revegetation of a natural waste is tending to produce forest; on Talim revegetation of an artificial waste is going on. The resulting admixture of tall grass and trees is a common one in the Philippines and is known as parang. The forest is cleared and the ground planted; the tall grass invades the patch, which is often abandoned. Trees gradually drive out the grass and a second growth forest takes its place. Frequently the dead grass is burnt off and the fight between trees and grass begins again. This parang type of vegetation is characteristic of the lower and more accessible slopes of Mount Maquiling. The original forest has been largely destroyed and the species of trees which have driven out the *cogon* and *talahib* have, in general, not been the ones of the original canopy. Here and there however are indications of what this was. On the steep banks of the Molawin Creek, representatives of the primaeval forest remain. One of these is the *bagtican lauan* (*Parashorea malaanonan*), a fine specimen of which is a landmark by the Molawin bridge on the campus of the College of Agriculture. It is concluded that the original vegetation of this area was dipterocarp forest such as is now found on Mount Maquiling from the parang to an altitude of about 600 meters. The main species of this formation belong to the Dipterocarpaceae, and the *bagtican lauan* (*Parashorea malaanonan*), *guijo* (*Shorea guiso*) and white *lauan* (*Pentacme contorta*) are characteristic. These three give valuable hardwoods, especially *guijo* the wood of which is fine grained and heavy and is used for boat and ship building, making vehicles and furniture and for interior work. These and other tall trees including a number which do not belong to the Diptorocarpaceae form the upper story of the vegetation. The lower trees are of varying heights and can hardly be classified into stories; their variations in height are more suggestive of steps. Chief among those of medium heights are *Diplodiscus paniculatus* (*bolobo*), *Dillenia philippinensis* (*catmon*), *Diospyros discolor* (*camagon*), *Nephelium mutabile* (*bulala*), and *Strombosia philippinensis* (*tamayuan*). *Dillenia* produces a fruit with a pleasant acid flavor reminiscent of that of the Red Astrakhan apple; these fruits are very common on the forest floor. *Strombosia philippinensis* belongs to the Olacaceae and might therefore be suspected of being a root parasite, but the plants so examined have shown no sign of such dependence. *Olax imbricata*, however, is an extremely vigorous root parasite. It is a scandent shrub found occasionally in the dipterocarp forest attacking a great variety of host plants.

Higher up the mountain the character of the virgin forest changes. The dipterocarps are no longer dominant, and their place is taken by species belonging to various other families. The trees are further apart. The transition takes place at about 600 meters, and the new formation, known as the mid-mountain,

Fig. 1.
Interior of rain forest on Mount Maquiling, showing tree fern, rattans, stem of erect palm, and climbing pandans.

Fig. 2.
Interior of mossy forest, showing rattans, ferns, pandans and fig.

PLATE I. TYPES OF VEGETATION ON MOUNT MAQUILING

or rain forest (Plate I, fig. 1), extends to about 1000 meters. Here the heights of the different components of the forest are not as variable as at lower altitudes and two stories of vegetation are distinguishable. The tall trees, such as *Quercus* and *Neolitsea* form the upper story and smaller trees, such as the giant nettle, *Laportea*, make up the lower. One of the most characteristic trees, though not the one with most individuals, is *Quercus soleriana*, an oak whose acorns may frequently be found along the trails. *Quercus mabesae* is known only from the type specimen which was collected in this region. Conditions in the rain forest are moister than in the dipterocarp forest, as is evidenced by the increased number of epiphytes and by the increased number of leeches on the ground and on the vegetation. As the elevation increases the presence of epiphytes becomes a more marked character, and when we come to the cloud belt at the top the trees are swathed in mosses, club mosses, filmy ferns, and other epiphytes (Plate I, fig. 2, and Plate II, fig. 1). This formation, very distinct in general appearance from the other two, is the mossy forest. The trees are low and twisted, never much over ten meters in height, and some very characteristic species occur here. The flowers are more conspicuous than at lower elevations and this is not solely due to the low stature of the trees. *Melastoma polyanthum*, the Philippine rose, with its showy pale purple flowers, is common; it is rather difficult to transplant successfully on account of the mycorhizae on its roots, but transplanting has been done and the plants have been found to grow well on the lowlands. *Medinilla*, *Dichrotrichum*, and various Begonias also produce striking patches of color. *Trichomanes apiifolium*, a filmy fern, produces exceedingly beautiful fronds under the moist conditions of the mossy forest, but on the lowlands this beauty cannot be maintained except under greenhouse conditions. The tree fern *Cyathea caudata* is characteristic at the summit flora and is one of the dominant species of the formation. In a few glades it produces an almost park-like effect. Its trunks when cut are beautifully figured, and are used to make picture frames and vases.

The four formations of the mountain merge into one another gradually. It is impossible to draw a sharp line of demarcation. The parang vegetation is recognized by the mixture of tall grasses and second growth trees; it is not a climax type and tends to give way to the forest. In the virgin forest, grasses (excepting a few bamboos) are practically absent. The dipterocarp forest has for its dominant members the dipterocarps, and the different species in this region vary in height considerably. In the midmountain forest, which resembles Schimper's rain forest, the dipterocarps are not the important group, but representatives of different families associate to form a distinct type in which there are two main stories of trees. The moss forest is an elfin wood differing from the others in its height, the numbers of epiphytes, and the species composing it.

PARASITES

Parasitic flowering plants are more conspicuous in the parang than in the virgin forest of the mountain, although the most interesting species occurs in the upper part of the dipterocarp forest. This is *Rafflesia manillana* which attacks the roots of a liana, *Cissus*. Its vegetative organs are very much reduced and are internal to the host. Towards the end of January the flower buds appear in rows along the *Cissus* roots. In this stage they resemble small cabbages. The mature flower is fifteen or twenty centimeters in diameter and has a strong car-

rion smell which attracts flies. These insects probably carry the pollen from the male to the female flowers. Apparently the *Rafflesia* plants are dioecious, as in the hundred or more flowers examined the flowers in each group belonged to the same sex, the number of males greatly preponderating. Collection of these plants is rather difficult, and several methods may be used. The small size, as compared with other species of *Rafflesia*, makes the Maquiling species particularly suitable for museum specimens. (*R. Schadenbergii* of Mindanao and *R. Arnoldi* of Sumatra have flowers with diameters of 80 centimeters and one meter respectively). The buds may be dried by exposure to sun. The internal parts crumble away but the outer parts dry in the natural form. Slicing of the buds or the mature flowers so as to make a section about a centimeter in thickness produces good herbarium specimens. These may be dried in a press in the sun or in an oven. The tissues blacken very readily, but exposure to sulphur dioxide for several hours while they are still moist improves their color considerably. Whole flowers are best preserved in alcohol; they discolor formalin very rapidly. The best place to look for *Rafflesia* is between the first and second camps in the dipterocarp forest, and the best time is at the end of February. Very often the best specimens of flowers are covered with ferocious small red ants and it is almost impossible to collect them. Spraying the flower with a little chloroform or ether is the most effective way of getting rid of these insects.

Balanophora micrantha is a root parasite found attacking the roots of *Ficus nota* at the foot of the mountain. It is best collected between September and January. In the rain forest another herbaceous parasite *Christisonia wightii* occurs in clumps, but it is rare. *Olax imbricata* is a sprawling shrub found in the lower parts of the dipterocarp forest, and has none of the appearance of a typical plant parasite. It attacks the roots of adjacent plants however with great vigor producing innumerable haustoria of varying size. These are very like those of the Indian Sandalwood (*Santalum album*) which belongs to the related family Santalaceae. They are conical, the top of the cone proceeding from the *Olax* root and the bottom attached to the host root. The tissue of the haustorium destroys the bark of the root and penetrates as far as the wood, from which it obtains water and salts. As the root grows it pushes the haustorium off and a deep scar is left to mark the point of attack. Haustoria may be collected from the surrounding plants, but occur most commonly on the roots of the *Olax* plant itself. This is to be expected because at the base of the plant the roots are very numerous and a great many come into contact with one another. Such self parasitism is inefficient, though it has been suggested that it may in some cases result in a shorter route for the passage of food materials to the stem.

Eight mistletoes are common. Five of them belong to the genus *Loranthus*, and three to *Viscum* (Plate II). *Loranthus philippensis* is found very commonly at lower elevations, particularly in the parang. In citrus groves it is a serious pest. *Cordia myxa* is a tree which suffers greatly from its attacks and *Ficus nota* is often heavily infested. The fruits of this *Loranthus* are eaten by different kinds of small birds, and this is probably the chief factor in seed dispersal. The fruit of *Viscum album*, a European mistletoe, is similarly eaten by thrushes and the seeds wiped from the birds' beaks on other branches. The

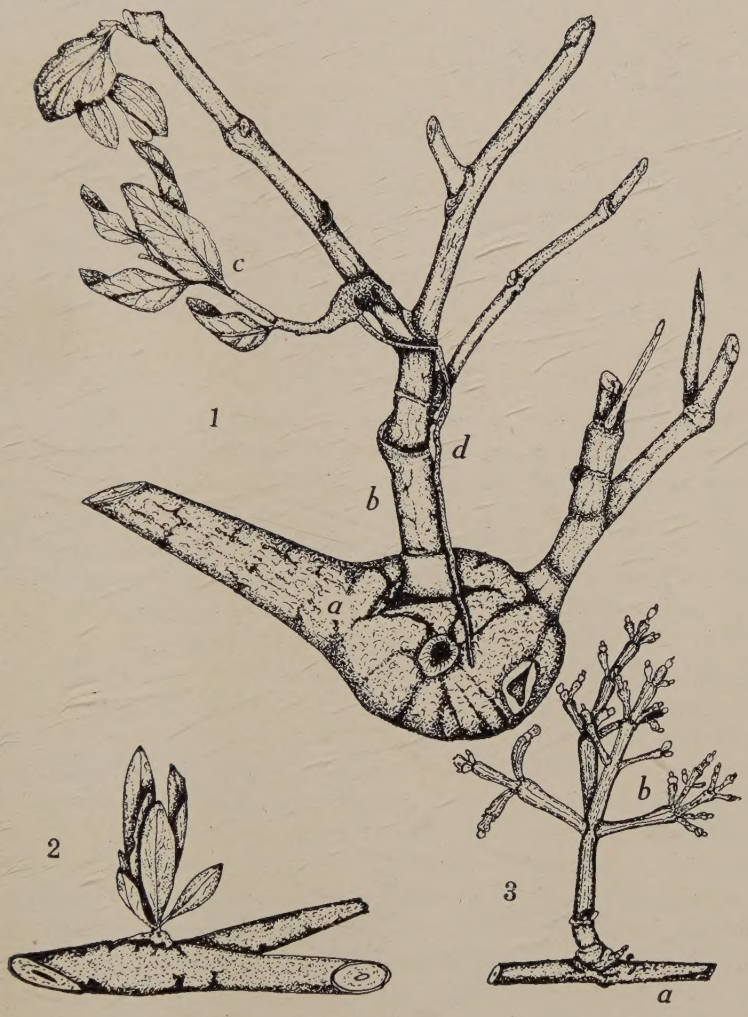

PLATE II. MISTLETOES

seeds of *Loranthus philippensis* germinate readily, especially on rough-barked trees. An anchoring disc at the end of the radicle attaches them firmly, and a lateral root creeps along the host branch sending down haustoria at irregular intervals. The development of these haustoria is not regular, as in the case of *Viscum album* for young and old haustoria are found interspersed along the root. Self-parasitism is common, especially in old plants where the roots become entangled with one another. Haustoria are sometimes formed independent of the host plant, and occasionally two from different roots may meet and fuse. This mistletoe may occasionally be found parasitic on *Viscum orientale*, and it is, itself, in turn, parasitized by a rather specialized species of *Viscum*, *V. loranthi* which is restricted to *Loranthus* (Plate II). *Viscum loranthi* is a small species rarely more than about twenty centimeters in height. Its leaves are reduced to minute scales, but its fleshy little jointed stems are green. It is tufted and does not creep over the surface of its host, nor through its tissues (as does the European *Viscum*). The relations of these species to one another in this very specialized chain of parasitism should prove very interesting, especially from the point of view of the differences in their ash constituents. *Viscum articulatum* resembles *V. loranthi* in general habit but is larger and has a wide range of hosts in two continents.

FIGS

The figs of Mount Maquiling play an important part in the vegetation from the parang at the base to the mossy forest at the summit, about seventy species having been recorded. Their growth forms are very diverse, ranging from lianas to stout trees. *Ficus megacarpa* is a liana easily located by its large fruits, ten centimeters long and eight centimeters in diameter, and is to be found scattered through the dipterocarp forest to the base of the mountain. *F. bakeri* resembles it in habit, but has smaller fruits. Rather lianoid in their younger stages are the strangling figs, or *baletes* which are perhaps the most striking plants of the dipterocarp and rain forests (Plate III, figures 2 and 3). These start life by germinating on the branch of a host plant, grow downwards and surround the trunk of the tree with a meshwork of coalesced roots. These roots finally strangle the host, which dies and, under the moist conditions of the forest rots quickly, leaving the fig standing like a tall cylindrical cage. It is not uncommon to find another species of fig acting as the host for one of these stranglers, of which there are about thirteen species recorded from Mount Maquiling. A strangling fig ultimately therefore becomes a tree independent of support by another plant; by the time the host has been choked the "trunk" is strong enough to support the crown. This trunk is in reality the coalesced roots of the plant and so marks the strangling fig definitely from the surrounding trees as regards structure. In appearance it is very different. The pseudo-trunk is deeply furrowed and convoluted with roots branching out and fusing again along its whole length. If the host plant was bent or if the *balete* started far out on a lateral branch, a number of columns of fused roots may support a single individual. Large buttresses are common and in this the fig resembles many Dipterocarps, such as *Parashorea*. The common belief that the *balete* is inhabited by demons (and that it is bad luck to cut the tree down) rests on more evidence than do many superstitions. Noises may frequently be heard in the labyrinths of the trunk and at night lights are often to be seen on it. The noises are probably due to frogs and

their enemies, the snakes, while the lights are from the numerous phosphorescent fungi of the forest. Phosphorescence is not uncommon amongst the Polyporaceæ. *Ficus elastica* is perhaps the best known strangling fig, and this species has been planted at the base of the mountain. Two of the commoner species with this habit occurring commonly in the forest are *F. clementis* and *F. calophylloides*, the latter often attaining almost 200 meters in height.

Some species, though not stranglers, have a sprawling habit, and something of the appearance of a *balete*. They may be found climbing on other trees or sometimes spreading over rocks, but are not powerful enough to strangle other trees; *Ficus repens* which occurs from the mossy forest down into the rain forest is of this type. *F. caudatifolia* of the rain forest encircles its host but cannot strangle it, and *F. subulata* of the dipterocarp forest lightly embraces rocks in the stream beds. There is a large number of species of *Ficus* whose growth form is that of ordinary trees. *Ficus odorata* is one of these and is common in the dipterocarp forest; its leaves though not noticeably scented in the forest have a definite fragrance when drying; they are very rough and are used for scouring. *F. hauili*, a common species of lower altitudes, has cauliflorous fruits which are eaten by bats. *F. nota* and *F. ulmifolia* are also excellent examples of cauliflory and are found very commonly. *F. nota* is often attacked by the creeping mistletoe, *Loranthus philippensis*. The fruits of *F. ulmifolia* are edible, but, like many wild edible fruits, little more can be said for them. One of the most peculiar of these fig trees is *F. pseudopalma*, which has a tuft of large leaves at the top of a slender trunk, the general effect being very palm-like (Plate IV, figure 1). *F. minahassae* (Figure 1) has peculiar cauliflorous branches densely packed with small figs. It is a very prolific species and the fruits are eaten by birds. *F. maquilingensis* is recorded from Mount Maquiling only, being found by cliffs near the summit.

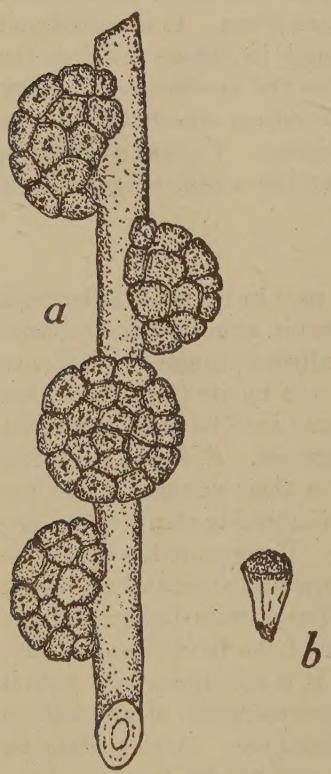

Fig. 1. *a*, portion of fruiting branch of Ficus minahassae. *b*, individual fig from a cluster.

PALMS

From the base to the summit, sometimes scattered, sometimes in thickets, the climbing palms are found. They belong to two genera, *Daemonorops* and *Calamus*, but the differences are not great and some authors have included them all under the name *Calamus*. Two species of *Daemonorops* are frequently seen in the lower parts of the dipterocarp forest; they are *D. mollis* which furnishes a good commercial rattan used in making chairs, and *D. ochrolepis* which is rather scattered. Some species of *Calamus*, such as *C. ornatus* have an edible, though hardly a delicious fruit. *C. siphonospathus* is abundant on Mount Maquiling, but is

Fig. 1.
View in transition zone between rain and mossy forest, showing tree fern and climbing pandans.

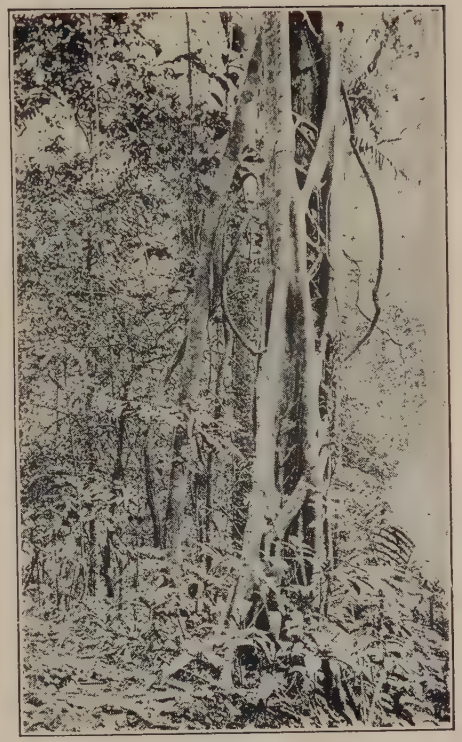

Fig. 2.
Strangling fig, showing network of roots with which it surrounds its host.

Fig. 3.
Strangling fig in the high forest of Mount Maquiling showing heavily buttressed base.

PLATE III. TYPICAL PLANTS OF MOUNT MAQUILING

of little use. *C. maximus* from lower elevations furnishes a good rattan used for pack saddles, baskets, and other articles. *C. discolor* occurs at medium elevations but is not commercially valuable. Scattered from the base to the rain forest is the beautiful fan-leaf palm, or *anahau, Livistona rotundifolia*. In the upper part of the dipterocarp forest small plants are very common, and are transplanted for use as pot plants. The mature tree, however, is very tall, its crown being amongst those of the first story trees.

The *cabo negro* (*Arenga pinnata*) is common at lower elevations in the virgin forest and on the lowland. The pinnate leaves of the mature palm in the virgin forest often attain a length of ten meters. The leaves break off with age, leaving a rough notched trunk. The axils soon become filled with epiphytes and humus and an old specimen may have small terrestrial trees such as *Carica papaya* and *Voacanga* growing from its trunk. On the lowlands the *cabo negro* will often be covered with large epiphytic ferns when practically all the other trees about are bare of them. The fruit, once deprived of its stinging crystals by boiling, is edible. Tough black fibre is produced at the base of the leaves in considerable quantities and is used for making a rope which is exceedingly durable in salt water; it is from this use that the plant receives its common name. Starch and sugar are obtained from the trunk, the sugary sap when tapped generally being allowed to ferment to produce tuba. *Arenga tremula*, the *dumayaka*, is much smaller and more ornamental than the *cabo negro*. It is found occasionally growing in clumps along the streams on the lower part of the mountain.

The fish tail palm, *Caryota cumingii*, is a beautiful tree with large bipinnate leaves which give it a fern like appearance in the distance. It is common on the mountain and is frequently cultivated. Its small round fruits contain stinging crystals, but the seeds are sometimes used as a betel nut substitute. *Pinanga insignis*, a slender palm with a crown of pinnate leaves, occurs rather commonly in the virgin forest but is nowhere as conspicuous as is the fish tail palm. The smaller *Pinanga barnesii* is found in the mossy forest at the top of the mountain, but is not very common; there are several specimens at the end of the trail. *Orania palindan*, a tall palm very like the coconut in appearance but with smaller fruits, is scattered through the forest at medium elevations.

POISON PLANTS

Plants capable of causing mechanical injury abound in the forest. As is to be expected in an area so rich in species, there are also a great many plants which are poisonous or which cause skin irritation. Both classes include plants possessing these undesirable characters to such a limited degree that they never cause any trouble. In the orange, for example, slight traces of hydrocyanic acid occur in the bark, leaf, and fruit, while the papaya is capable of causing skin irritation by virtue of the presence of the proteolytic enzyme papaïn in its latex. A list of such plants would be extremely long. Hydrocyanic acid occurs very widely distributed through the flowering plants, and the number of such species from Mount Maquiling alone runs into several hundreds. Some of these occasionally develop a large amount of the poison and produce fatal results when eaten. In the Philippines, *Phaseolus lunatus*, the Lima bean, has caused deaths of human beings in this way, while *Passiflora fœtida*, a parang plant, has poisoned fowls at the College of Agriculture. The coconut contains considerable amounts of hydrocyanic acid, but fortunately most of this is in the stem and the pericarp.

A number of foreign plants of a poisonous nature have been planted at the base of the mountain, and some have become established as naturalized aliens. *Datura alba* (*D. metel*), the thorn apple, grows commonly along the railway line. It is an extremely poisonous plant though fortunately is not attractive to stock. The leaves, as in other countries, are smoked locally to relieve asthma. *Strychnos nux-vomica*, the strychnine plant and *Erythroxylon coca*, the cocaine plant, are occasionally planted experimentally. *Jatropha curcas*, the physic nut, and *J. multifida*, introduced from America, are widely planted for ornamental purposes; the former almost caused the death of a student at the College of Agriculture this year when he ate some of the seeds in mistake for peanuts.

Two common trees found around the base of the mountain are *Aleurites trisperma* and *A. moluccana*. The seeds are strongly purgative, but are eaten without danger after they have been roasted. *Dioscorea hispida*, a common parang yam, has large tubers which when eaten raw are poisonous. After prolonged washing and cooking they are edible. The poisonous properties of the plant are utilized for the treatment of myiasis in stock, and Burkill of the Singapore Botanic Gardens says it is sometimes used for poisoning tigers.

Macrozanonia macrocarpa is a reputedly poisonous cucurbit often climbing to a height of ten meters in the forest. Its large globose fruits with their winged seeds make it one of the conspicuous plants of lower elevations. *Rourea erecta*, a sprawling shrub, and *R. volubilis*, a vine, are scattered through the dipterocarp forest, and are poisonous. The wood of the former and the fruits of the latter are used for poisoning dogs. Eight species of *Derris* occur on the mountain and the surrounding plain and two of them, *D. philippinensis* and *D. elliptica*, are well known for their use as fish poisons and insecticides. Though the poisonous principle, derrin, is found in the aerial parts of these vines as is shown by the records of death of cattle from eating them, the roots are specially toxic. They are usually pounded before use as fish poisons. The commercial value of these plants lies in their insecticidal value which is considerably enhanced when the material is mixed with tobacco.

A common leguminous vine at lower elevations is *Abrus precatorius*, the red and black seeds of which are used for necklaces. These seeds are very poisonous, the active principle being abrin. *Lophopetalum toxicum* is a tree, the sap from the bark of which is used by the Negritos as an arrow poison. A similar use is found for the sap from the bark of *Alstonia scholaris* (*dita*), which is said to have been used on bolos during the revolution.

A large number of local plants are used as fish poisons, many of them depending on the presence of saponin for their poisonous properties. The most generally used local species are *Albizzia acle*, *A. saponaria*, *Anamirta cocculus*, *Barringtonia* spp., *Derris* spp., *Croton tiglium*, *Entada phaseoloides*, *Harpullia arborea*, *Jatropha curcas*, *J. multifida*, *Macrozanonia macrocarpa*, *Nicotiana tabacum*, *Piper corylistachyon*, *Sapindus saponaria*, *Vitex glandulosa*, and *Voacanga cumingiana*. A number of these are foreign species commonly planted around settlements and therefore often more readily available than the native plants. *Entada phaseoloides* (*gogo*) contains a considerable quantity of saponin and on this account its crushed stems are widely used for the making of shampoos. *Leucaena glauca* (*ipil-ipil*), used in Malaya as a fish poison, does not seem to be very reliable for the purpose as far as is indicated by experiments at the College of Agriculture,

though it causes the dropping out of hair when eaten by horses. Plants causing skin irritation, such as *Arenga pinnata* and *Caryota cumingii*, are sometimes used by fishermen; their action, however, is due to the irritation which they produce in the gills, and not to any poisonous principle.

SKIN IRRITANTS

It is difficult to draw a hard and fast line between plants causing simple mechanical injury and those which cause skin irritation proper. There is a pronounced difference between the effects of a thorny plant, such as *Acacia farnesiana* and those of a plant with stinging hairs, such as *Laportea*. The difference between these stinging hairs and the stiff deciduous hairs of some grasses, such as *aguiñgay* (*Rottboellia exaltata*) is not so marked. The primary effect of each is the piercing of the skin by the hair; in *Laportea* the effect is enormously aggravated by the injection of an irritant, formic acid, while with *Rottboellia* it is limited to this initial piercing; the latter, however, is sufficiently annoying to cause *Rottboellia* to be regarded as a plant causing skin irritation. Having included this grass we are forced to include others whose irritating properties are relatively feeble. Rice and sugar cane, by reason of their rather harsh leaves, cause chafing of the skin of harvesters and this is aggravated by the toiler's perspiration. Such an action is due to foreign matter rather than to the plant. It is therefore intended to include as skin irritants only those plants whose action depends either wholly or in part on chemical and not mechanical action. A list of the more important plants causing mechanical irritation naturally falls into two sections; in the first, the irritation is due to the presence of urticating hairs and in the second to the presence of some substance in the tissues which is apparent only when the juice comes into contact with the skin.

Three species belonging to the genus *Laportea* and one belonging to *Fleurya* are notorious for their urticating siliceous hairs. The nettle family, to which these genera belong, is well represented on Mount Maquiling, but the other genera such as *Boehmeria*, *Cypholophus*, *Pipturus* and others, do not possess stinging hairs. *Laportea gigas* of Queensland has been investigated by Petrie who finds that both formic and oxalic acids are present in the hairs, the former being predominant. In *Urtica*, the common temperate zone nettle, the irritant is formic acid. Though the local species have not been analyzed it is to be expected that they will be found similar to the Queensland plant. *Laportea meyeniana* is a shrub or small tree fairly common in the lower regions of the mountain and in the parang. *L. subclausa* and *L. luzonensis* are more commonly found higher up the mountain in the dipterocarp forest and in the rain forest. They are very common and in places form thickets. Their leaves are large and characteristic, so that they can usually be avoided. *Fleurya interrupta* is a small species common at the base of the mountain. The common treatment for injuries from these plants is the application of coconut oil. This gives a certain amount of relief, but is in no sense an antidote. The soothing effect of the split petioles of aroids is taken advantage of in Queensland for the same purpose, but as many of the aroids on Mount Maquiling themselves possess irritating properties, this treatment is not to be recommended. The best way to stop the irritation is to remove the cause and this is best accomplished by swabbing the affected part with a solution of an alkali, such as ammonia or sodium carbonate.

Somewhat similar in effect but different in cause is the irritation produced by the juice of numerous plants on the mountain. In the lower elevations a vine, *Semecarpus cuneiformis* (*ligas*), of the Anacardiaceæ, is often encountered. Some people are very sensitive to it and often suffer from painful swellings where they have come into contact with it. The action resembles that of the poison ivy, though the cause of the trouble is not known. *Anacardium occidentale*, the cashew, is a tree that is not native but is planted round the foothills for the sake of its fruit; its action is somewhat similar to that of *ligas*. The nut produces an irritant substance, cardol. One common name, the coffin nail, sums up the reputation of the cashew; the pulp, however, though fibrous, has a very pleasant acid taste and is harmless. The latex of the mango, another anacardiaceous plant, also produces irritation, the local treatment, as for most irritations, being coconut oil.

By far the greater number of plants on Mount Maquiling causing skin irritation contain stinging crystals. These are raphides of calcium oxalate, and produce an initial piercing of the skin, and through the minute wound a proteolytic enzyme enters and produces the main effect. The crystals themselves produce a light prickling sensation but the enzyme is necessary to produce the violent pain characteristically caused by the juice of so many local plants. A few plants with raphides, such as *Homalomena philippinensis* and *Cyrtosperma merkusii*, have no stinging properties. Others with about the same quantity, such as *Caladium bicolor* and *Xanthosoma maculatum* are definitely irritating. The difference lies in the absence or presence of the enzyme.

Arenga pinnata, the *cabo negro*, or sugar palm, is common in the dipterocarp forest and in parangs. Its fruits, which are up to two centimeters in diameter and occur in immense quantities, contain a great quantity of stinging crystals. These were formerly used for hell-broth, and are still used for scattering, crushed, around fish ponds for protection against barefooted nocturnal robbers. They produce an intense burning pain which may last for several days. *Caryota cumingii*, the fish-tail palm (Plate IV, figure 2), has similar properties. Its fruits are small and round and about a centimeter in diameter. *Arenga tremula*, a palm not as commonly found on the Mountain as these other two, also has stinging crystals in its fruits.

An interesting point is that *Laportea* and *Fleurya* would be irritating plants even without their trichomes. Stinging crystals are present in their leaves and produce a slight irritation. Many of the aroids on the mountain are objectionable in the same way. *Amorphophallus campanulatus* has considerable quantities of raphides in its corms and petioles. The corms are used for pig feed after they have been boiled. The heat destroys both the enzyme and the raphides so that the cooked material is harmless. This species, with *Raphidophora merrillii*, *Alocasia zebrina*, *A. sanderiana*, *A. indica*, *A. portei*, *A. heterophylla*, *Caladium bicolor*, *Colocasia esculentum*, *Homalomena philippinensis*, *Xanthosoma sagittifolium*, and *X. maculatum* are amongst the numerous aroids with stinging crystals. The natural antidote is an enzyme poison and ammonia is the reagent which has proved most suitable. Destroying the crystals after penetration is out of the question and would be of no use unless the enzyme were destroyed also. The irritation of the most objectionable species (*Arenga* and *Caryota*) is relieved in few minutes by swabbing with a strong solution of ammonia.

Fig. 1.
Ficus pseudopalma

Fig. 2.
Caryota cumingii

Fig. 3.
Nephentes alata

PLATE IV. TYPICAL PLANTS OF MOUNT MAQUILING

ORNAMENTAL AND PECULIAR PLANTS

Thorny plants are more characteristic of desert habitats than of well watered regions, but a large number of such species occur in the forest. The principal ones are the rattans, *Calamus* spp. and *Daemonorops* spp., whose species frequently catch bats by the wings. These plants are extremely common in both the rain forest and the dipterocarp forest and in places form spiny and almost impenetrable thickets.

Enormous buttresses radiate from the base of many of the trees of the dipterocarp and rain forests. The most striking examples are afforded by the *bagtican lauan* (*Parashorea malaanonan*), the *kupang* (*Parkia timoriana*), and various strangling figs. These structures are probably of great assistance to shallow-rooting species during wind storms. Prop roots are produced by a number of trees, notably the various species of *Pandanus*, some specimens of which reach a height of thirty meters in the upper dipterocarp forest. These roots, though structurally different from buttresses, are equally effective during storms. *Leea manillensis* produces small prop roots, but their production is mainly dependent on water conditions, and in damp habitats similar roots are often produced high up on branches.

The growth forms of the lianas of the mountain are extremely interesting. Long thread-like roots and pendant branches swing from the tree tops and are blown from tree to tree, forming festoons. Many of them strangle their hosts with their heavy rope-like coils. This strangling habit is not uncommon in stout vines and lianas which offer strong resistence to growth of the tree which they encircle. The growth of the host stem frequently results in peculiar growth forms in the liana, which, restricted in its growth on the inner side, thickens laterally. The formation of successive layers of phloem and xylem in such cases is not uncommon.

Orchids are very numerous on the mountain both as epiphytes and as terrestrial plants, but most of them are inconspicuous. Green flowered species are especially abundant, but the showy ones, being generally hidden in the tree tops, are rarely seen. Often fallen flowers of the large white butterfly orchid, *Phalaenopsis amabilis* var. *aphrodite*, are found on the forest floor at the base of the dipterocarp forest, but the plant itself is too far up in the trees to be seen. This species makes a fine hanging plant, but unlike many other epiphytic orchids cannot be propagated vegetatively. *P. luedemanniana* is an ornamental species with smaller flowers and is occasionally found on the mountain. The best time for collection of many epiphytes is after a typhoon when large branches, often heavily laden with ferns and orchids, are lying on the ground. *Eria vulpina* is a peculiar hairy leaved orchid with attractive flowers but as these are usually hidden on the under side of its branches they lose most of their ornamental value. *Epipogon roseum* is terrestrial and its pink flowers are often seen in the dipterocarp forest amongst the ground covering. One of the showiest of the Maquiling species is *Habenaria robinsonii*. This small grass-like orchid grows in masses on rocks in the creek bed, and its white flowers, two or three on each plant, all bloom together. It is easily cultivated, requiring no more attention than regular watering but it flowers only once a year and then for two or three weeks only.

Pogonia is a curious little orchid whose flowers appear in the dry season after the leaves have withered away. Its flat basal leaf is commonly found in the lower parts of the forest, in the parang, and even on lawns. *Spathoglottis spicata*, a purple flowered epiphyte often grows on the ground in dry spots. It flourishes as a pot plant, flowering throughout the year except for a few weeks at the end of the dry season. Two orchidaceous vines, *Vanilla philippinensis* and *Galeola hydra*, are scattered through the forest. The latter is saprophytic, and has conspicuous yellow flowers.

Ferns vary from small epiphytic forms to trees and creepers. They reach their maximum development in the mossy forest where *Cyathea caudata*, a tree fern, is one of dominant species. This plant will grow in the lowlands if it is kept constantly moist, but in a country where most plants need so little care this has been a fatal barrier against its cultivation. The humus gathering ferns *Aspidium nidus* (the bird's nest fern) and *Drynaria quercifolia* offer a marked contrast to the tree ferns in the amount of care they need under domestication. The bird's nest fern is easily grown from spores and in a year or more the plants attain quite a considerable size.

Some species of *Adiantum* reproduce vegetatively by producing new plants at the ends of their fronds. *A. caudatum*, a delicate little plant common along the mountain trails, does this very commonly. If the new plant does not come into contact with the soil it soon withers and dies, the water supply from the mother plant not being sufficient to support it. If, however, it becomes established the new plant will produce further offshoots. In plants growing by streams the supply of moisture is sometimes sufficient for these walking ferns to produce a series of plants although they may never touch the soil. *Adiantum alatum* (Plate V) is another very common fern with this habit. *Ophioglossum pendulum* is a beautiful mossy forest species with pendant frilled leaves and grows well when removed to the lowlands. The filmy ferns from the cloud belt are generally small, but *Trichomanes apiifolium* has large fronds with delicate semi-transparent leaflets. Somewhat similar in appearance is a plant from lower elevations, *Asplenium laserpitiifolium*, which requires very little attention in cultivation.

Raphidophora merrillii is a climbing aroid widely spread at lower elevations especially on rough-stemmed trees, such as the sugar palm (*Arenga pinnata*). Its large incised leaves are very characteristic. Other species, such as *R. stenophylla* have entire leaves. At the summit two species, *R. monticola* and *R. stenophylla* represent the genus. The plants frequently germinate on branches and their roots grow downwards very rapidly. In the case of the common *R. merrillii* the rate is often about 3.8 centimeters a day during the dry months. The rapidity of growth is due to the length of the growing zone which is from 66-82 millimeters. The length of this zone in the roots of the coconut and the velvet bean is generally only about 10 millimeters. Among the numerous other aroids two of the most conspicuous species are *Alocasia indica*, a very large plant with a well developed trunk, and *Colocosia zebrina* whose leaf and flower stalks are light green banded with dark green. The large single much-divided leaves of *Amorphophallus* are common in the parang and are found less frequently in the dipterocarp forest. These die off during the dry season, and at the beginning of the rainy season (generally in May) the flowers appear. Set close to the ground

PLATE V. ADIANTUM ALATUM

in the parang are found the large campanulate flowers of *A. campanulatus*, very ornamental in appearance, but with a very objectionable carrion odor. This odor originates from the appendage and attracts carrion flies which assist in fertilization. The species in the dipterocarp forest, *A. rivieri* var. *konjac*, has flowers more of the ordinary arum type and attaining a height of over a meter and a half. These, too, have the carrion odor, but it is not as strong as that of *A. campanulatus*. The odor is developed a little time before the dehiscence of the anthers, and is gradually lost after the pollen has been shed.

A beautiful ornamental tree occurring at low altitudes is *Lagerstroemia speciosa* whose large pinkish purple flowers form bright masses at the beginning of the rainy season. Cuttings grow very readily. The blossoms are very conspicuous on isolated trees, but in the forest, because they occur in terminal clusters, are usually hidden from below by the large leaves of the crown. *Leea manillensis* with large umbels of small red flowers is a small tree common in the parang formation, and scattered through the dipterocarp forest. Its flowers are very attractive to butterflies, and a number of birds also visit them. *L. luzonensis* takes its place at middle elevations on the mountain. Occasional trees of *Citrus hystrix* is found in the dipterocarp forest; its fruits look very much like those of the cultivated orange, but are very sour.

In the dipterocarp forest a vine with beautiful bluish green trusses of flowers is occasionally found. This is *Strongylodon macrobotrya*. Its flowers are generally inaccessible, and seed is rare owing to the attacks of weevils. This destruction of seed is a common state of affairs with many wild legumes. The flowers of various species of *Hoya* have very delicate coloring. *H. luzonensis* has rather insignificant flowers but is very hardy and grows as an epiphyte in the most unfavorable places. *Freycinetia*, another vine, has bright red bracts. The cut flowers last for weeks without wilting or changing color.

Climbing Begonias are conspicuous in the mossy forest, but occur also in the forest at lower elevations. In the dipterocarp forest they are not so much in evidence because of the greater height of the trees on which they grow. *B. aequalis*, a pink flowered vine, is common on tree trunks at the summit, and is occasionally found on fallen branches at the base of the mountain. The large-leaved *B. oxysperma* flourishes best in the cloud belt, but *B.*

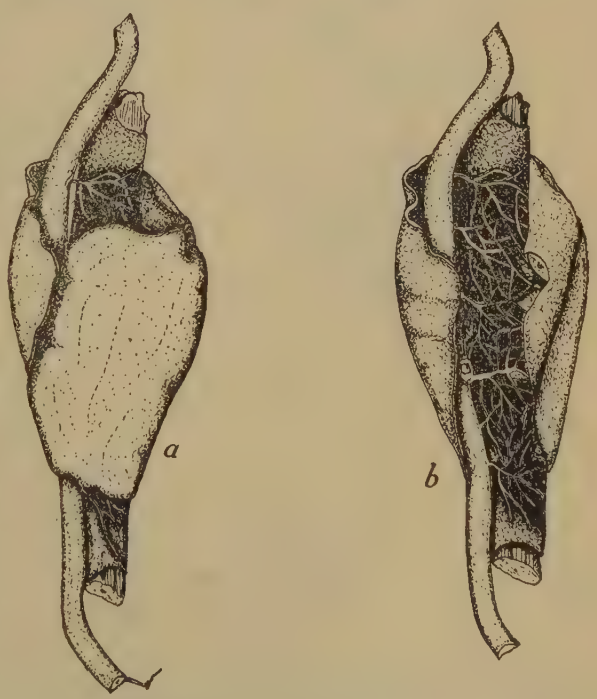

Fig. 2. Dischidia, *a* showing leaf sac, *b* with one leaf removed to show roots in the cavity.

nigritarum, a mat like plant, is common on rocks in the creek beds at low elevations. This latter species lends itself well to cultivation, blooming profusely under ordinary conditions for the greater part of the year.

Pitcher plants are found growing as epiphytic vines in the mossy forest. (Plate IV, figure 3). They belong to the variety *ecristata* of *Nepenthes alata*, the common Philippine species. In the Mountain Province, *Nepenthes alata* grows as a semi-prostrate terrestrial plant, and may reach a length of two meters or more. The Maquiling form, which has been described as a distinct species by Elmer under the name *H. graciliflora*, is smaller and epiphytic. It makes a beautiful hanging plant, but is rather slow in its growth from seedlings in the lowlands. The pitcher is borne on a prolongation of the midrib which in old specimens becomes more or less spirally twisted, sometimes in an anti-clockwise, but generally in a clockwise direction. This often assists in the anchoring of the shrub. The pitchers, as is well known, contain a small amount of fluid containing a proteolytic enzyme. This is present before the lid of the pitcher opens, and is the result of gland action on the inner surface. The lid opens so as partly to cover the mouth of the pitcher and keeps out rain to a certain extent, so that dilution of the secretion is minimized. Though the fluid is definitely proteolytic and will digest most insects and corrode cubes of hard-boiled white of egg rapidly, mosquito larvae thrive in it, and are often found amongst the partially digested bodies of ants, beetles and other insects.

Fig. 3. Myrmecodia echinatus. (1) young plant reduced. (2) seedlings, *a*, shortly after germination, *b*, after appearance of the cotyledons (x 2)

Many plants are inhabited by various species of ants. The paper nest ants build large nests in numerous different species of trees, native and foreign alike. Others inhabit hollow organs after some injury has provided an entrance. A small red ant inhabits the petioles of dying papaya leaves. *Dischidia*, an asclepiadeceous genus (Figure 2), has sac-like leaves in the cavity of which its roots grow, and which are often used as a shelter by ants. *Myrmecodia* (Figure 3) and *Hydnophytum* are small shrubs with swollen bases with special cavities for the harboring of ants. These bases may be over twenty centimeters in diameter and are tunnelled so as to be almost spongy. Ants are apparently not necessary for the protection of *Hydnophytum* at least, as they are to many ant plants. A specimen of *H. formicarium* removed from a tree in the dipterocarp forest has been kept at the base of the mountain for almost two years now without ants in its cavities and has not been attacked by other insects. When the plant is deprived of water, the leaves continue turgid at the

expense of the water in the base which gradually becomes flaccid. It is very probable therefore that this function of reserve water storage is more important to these epiphytes than that of harboring protective ants. The plants themselves are not rare, but as they grow high up on branches are usually only found after heavy winds. During the rainy season a search of a branch to which *Hydnophytum* or *Myrmecodia* has been attached will occasionally result in the finding of a few seedlings. The radicle becomes swollen before the cotyledons have broken free from the seed and grows rapidly. The tuberous base is therefore a modified root. *Polypodium sinuatum*, a climbing fern, and *Lecanopteris* (also of the Polypodiaceae) have similar cavities but are rare on Mount Maquiling. Coleopterous larvae sometimes tunnel the rhizomes of ferns (*Drynaria quercifolia*, for example) and these cavities later become inhabited by ants.

ILLUSTRATIONS

PLATE I. Types of vegetation on Mount Maquiling.

Figure 1. Interior of rain forest showing tree fern (*Cyathea*), rattans (*Calamus* spp.) and climbing pandans (*Freycinetia* sp.)

Figure 2. Interior of mossy forest showing rattans, ferns, pandans, and the trunk of a fig covered with epiphytes.

PLATE II. Mistletoes.

Figure 1. *Loranthus philippensis* (*c*) parasitic on *Viscum orientale* (*b*) which is parasitic in turn on *Mussaenda philippica* (*a*); (*d*), root of *Loranthus*.

Figure 2. Seedling of *Loranthus philippensis* established on an old plant of its own species.

Figure 3. *Viscum loranthi* (*b*) parasitic on *Loranthus philippensis* (*a*).

PLATE III. Typical plants of Mount Maquiling.

Figure 1. Transition zone between rain forest and mossy forest showing tree fern and climbing pandans.

Figure 2. Old strangling fig, showing heavily buttressed base.

PLATE IV. Typical plants of Mount Maquiling.

Figure 1. *Ficus pseudopalma* (centre) with the introduced Royal Palm (*Oreodoxa regia*) on the right.

Figure 2. *Caryota cumingii*, the fish-tail palm.

Figure 3. *Nepenthes alata* var. *ecristata*, a pitcher plant from the mossy forest.

PLATE V. *Adiantum alatum*, a walking fern, showing mode of vegetative reproduction.

A REPORT ON A SHORT VISIT TO JAVA[1]

By Nemesio B. Mendiola

Of the Department of Agronomy

This trip was made in January, 1924. I went to Java because this country is supposed to have the best plant breeding stations in the tropics and I wanted to get the latest information on the methods of tropical crop breeding. It is a matter of personal disappointment that means did not permit my visiting the cane breeding work in Pasoerocan, Java and the tobacco work in Medan, Sumatra.

The agriculture of Java is similar in many respects to that of the Philippines, and what the Dutch Government has done in its agricultural stations in Java should be of greater interest to our agronomists than the work of similar stations in temperate countries. I would strongly recommend that our technical men be sent, at least once every five years, on a trip to Java and countries of similar agricultural conditions and development.

I desire here to acknowledge indebtedness to Dean C. F. Baker for letters of introduction which facilitated my arrangements in the Philippines for the trip and were "Open Sesame" in Java at all scientific doors.

AT THE PLANT BREEDING STATION FOR ANNUAL CROPS

Most of my visit to the Department of Agriculture, Commerce and Industry in Buitenzorg, Java, was spent in the Plant Breeding Station for Annual Crops. Mr. L. Koch is at the head of this institution. I am under deep obligation to him for his kindly courtesy in going with me from place to place in the Station and explaining the different experiments under way. I desire also to express appreciation for the aid given me by Mrs. L. Rottoseel, one of Mr. Koch's assistants. A part of my time was spent with the head of the Station for Permanent Crops, Mr. Van Helten. I had also the pleasant privilege of meeting Dr. P. J. S. Cramer, now the Director of the General Experiment Station, Department of Agriculture, Commerce and Industry of Java.

The crops I saw growing in the Station for Annual Crops were, among others, lowland and upland rice, mostly the first; maize; cassava; forage crops, such as the Napier grass, guinea grass, sorghum and one or two others; soy beans; peanuts; fiber hibiscus; and several green manure crops, the most important of which were *Crotalaria usaramoensis*, *Crotalaria anagyroides*, said to be very good cover plants, and *Mimosa invisa*.

RICE AND GREEN MANURES

The best varieties of rice in Java are said to be the Carolina and the Carantanga.

With rice, the experiments which impressed me were those on the effect of green manure; on the reduction of expense in cultivation; on obtaining increased yield by different systems of weeding and planting; and on what seems to me a

[1] General contribution from the College of Agriculture No. 117.

new plant breeding method of obtaining increased yield. The creation of pure lines of rice by clonal propagation also attracted my attention.

I was told that the matter of green manuring is of great importance to Javan agriculture. Experiments in this line in Buitenzorg have been going on for many years and have already begun to produce very favorable results. Among the plants used for green manuring, as already mentioned, are *Crotalaria usaramoensis, C. anagyroides,* and *Mimosa invisa.* These plants are rather hard to plow under. But once sown they perpetuate themselves in the field, provided they are allowed to ripen and drop their seeds before the plowing is done.

The details of some of the experiments and results on green manuring may be learned from two papers, copies of which were kindly sent me by Mr. Koch[2] after my return to the Philippines. Besides the three species named above, eleven others were used in the green manure studies. These were: *Indigofera sumatrana* Gaertn., *Tephrosia Vogelii* Hook., *Cassia mimosoides* L., *Phaseolus semierectus* L., *Tephrosia candida* DC., *Phaseolus lunatus* L. (Koro minti), *Centrosema Plumieri* Benth., *Indigofera hirsuta* L., *Tephrosia Hookeriana* W. et A., *Desmodium gyroides* DC., and *Cajanus indicus.*

Under Buitenzorg conditions, *Crotalaria usaramoensis, C. anagyroides* and *Indigofera hirsuta* are ready to be plowed under at the age of 4-5 months. The other species are ready at later or different ages. I understand that *Crotalaria usaramoensis* and *Mimosa invisa* are highly recommended for cover crops in palm oil plantations in Trinidad, West Indies. *Mimosa invisa* is also being used as a cover crop for abaca in the Kuala Lumpur Experiment Station. I brought back with me seeds of the most important of these green manure crops and they are now under multiplication for future tests. *C. usaramoensis* is known to produce a fairly good fiber.

The cleanliness of the fields has been pointed out by almost every Filipino technical man who has visited Java. It has been said with truth that the Javanese garden their fields. Knowing this, I was surprised to find that a more efficient system of weeding is still one of the aims of Buitenzorg investigations. A study is being made of the comparative advantages of: (a) using animal labor and hand labor in weeding; and (b) the Chinese and Italian hand weeders. The Italian weeder, which was brought from Italy by Mr. Koch himself, consists of a handle about the size of that of an ordinary garden hoe with two blades arranged at right angles. The implement works backward. To prevent unnecessary sinking into the mud an iron plate is placed on the same level as the blades. I saw this implement being used by women laborers in lowland rice fields. Another hand cultivator being tried on upland cultures, is a local device very similar to a Planet Junior cultivator except that the roller is made of wood but tired with iron, and instead of several blades, there is only one which is similar to the Philippine *panutsod.* Three widths of blade, 15, 20 and 25 centimeters, are used, depending on conditions. The blade is easily detachable and replaceable. The price of the implement, including the three blades, is 10 gulden or about ₱7.50 Philippine currency. These two types of implements might, with advantage, be introduced into the Philippines. My impression is that they have been

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2 These papers are: (1) Koch, L.: Proefsnitten en analyses van eenige groenbemesters; and (2) Koch, L.: Proeven over de uitwerking van groenbemesting bij mais, published in No. 35 and No. 36 respectively of the *Korte Berichten uitgaande van het Algemeen Proefstation voor den Landbouw, onderafdeeling zaadteelt van eenjarige gewassen.*

found to be more efficient and labor saving than other similar devices. For particulars about the upland weeder, those interested may refer to Mr. Koch's paper.[3]

As regards rice, my greatest interest was in the plant breeding work the Buitenzorg men are doing, especially in pure line selection. I consider this line of work in Java as having important direct bearing on similar work which is being done in this College. I was very anxious to discuss this work with the Buitenzorg men because the reports which had reached me about it had been rather conflicting. For example, from the report of Doctor Copeland[4], former dean of this College, on his Java trip in 1915, success in selection work in Buitenzorg was to be expected. Doctor Copeland reported: "All selection work is along pure lines, the individual plants being the basis. It has been evident from the start in Java, as here, that the named local varieties are themselves mixtures so diversified that they are not in their natural condition fit subjects for selection" of varieties. According to this, the Javan varieties should have proved good material for isolation of high yielding pure lines, that is, for pure line selection. But when Mr. Silverio Apostol, now Acting Secretary of Agriculture and Natural Resources of the Philippines, came back to this country from his rice tour around the world in 1920, the first thing he mentioned to me was that the rice workers in the Dutch East Indies no longer believed in line selection and that they were attempting to find out if greater yield might not be obtained by planting mixed lines, something that is exactly the reverse of line isolation. That the results of pure line selection of rice in Buitenzorg were indeed unexpected and disappointing is at once evident from the contents of a number of tables published by Mr. Koch in 1918[5] but which became accessible to me only this year.

But again, in 1921, it appeared from the report of Viellard[6] that the work on rice improvement in Java was attended with promising results. To quote Viellard: "At Java, up to the present time, a dozen varieties have undergone this method of selection and have furnished twenty pure lines. These lines multiplied over large areas, for the last 2 or 3 years in control plots, have shown homogenicity and fixed characters as expected. With regard to the yield, there was an average increase of 20%". As regards the results of hybridization, he reported: "Certain hybrids flowered 8 days earlier than Carolina (the variety which matures the quicker of the 2 parents). Others gave larger grain than Carolina. These facts are sufficiently encouraging to raise hopes, and the confirmation of the results obtained at Tjikenmeuh will open up an efficient means of action to rice breeders for the improvement of local varieties, by crossing with superior important varieties".

In the face of such conflicting reports I was naturally eager to obtain first hand information in Java. This was what I found out: Mr. Koch explained to me that he began the line selection work with the expectation of increased yield. A goodly number of varieties were used. Strains were isolated in the usual plant-to-the-row manner, multiplied and compared with their corresponding popula-

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3 Koch, L.: Landbouwwerktuigen. *Korte Berichten uitgaande van het Algemeen Proefstation vor den Landbouw, onderafdeeling zaadteelt van eenjarige gewassen*, No. 37.

4 Copeland, E. B. Java and the Philippines. The Philippine Agriculturist and Forester 4: 1-28. 1915.

5 Koch, L. Onderzoekingen betreffende de praktijk-waarde van de lijnenselectie methode voor verschillende eenjarige landbouwgewassen. *Teysmannia* 29en Jaargang, 1-36. 1918.

6 Viellard, P. Improvement of rice by selection and hybridization in Java. Monthly Bul. of Agric. Intelligence and Plant Diseases, Year XI, No. 5. *Cited in Tropical Agriculturist* 57: 232-233. 1921.

tions. The results were most disappointing. It was found that more often the yield of the selected strains was either less than or only equal to that of their corresponding parent populations, that is, the non-selected portion of the varieties. It was then suspected that a population yielded more than its component lines individually as the population is probably more adapted to a greater variety of conditions in the field than a single line is. Acting on this suspicion, the Buitenzorg workers began to mix selected lines and plant them in comparison with unmixed lines and also with natural populations. It was found that an increased yield was obtained in this way but that the increase was not enough to make the practice profitable. Mixing different varieties gave similar results. So even this method of improvement was abandoned. It may be said here that line selection and mixing of lines with peanuts were found of no avail also.

As to hybridization work, it may be said that too much was expected of it if it was begun with the idea of obtaining immediate practical success. It was started before the hereditary behavior of rice characters was well understood. It is now known, through the researches of Koch, Van der Stok, and others, that such characters as beardedness, color of glume, color of grain, etc., segregate in a Mendelian way in the second filial generation of a hybrid and that, in view of this segregation, it would take a considerable number of individuals and generations to fix a character or isolate the hybrid that is desired. But it is a difficult matter to obtain rice hybrids in a considerable number, unlike hybrids of other plants, such as tobacco. After ten years of work (1907-1917), Mr. Koch said, he was unable to isolate a non-segregating rice hybrid, so that hybridization work has been abandoned as a method of obtaining improvement, as well as line selection on a large scale. Mr. Koch is trying a new method, similar to the ear-remnant method of corn selection. The results of this new venture will be awaited with much interest in the Philippines.

As to the reasons believed to be responsible for the failure of line selection as applied to the Javan rices, Mr. Koch holds that the Javan varieties consist of strains too closely related to each other, as he expressed it, or these varieties may be taken to be highly homogeneous. It may be of interest to mention at this point that the more progressive Javanese rice growers practice some kind of seed selection and that the common method of harvesting rice is by cutting the heads one by one, a practice which would make possible the careful selection of phenotypically desirable seeds or plants. This method of harvesting is resorted to in the Philippines in case of bearded varieties to allow threshing by hand; threshing by trampling being almost out of the question.

One of the rice experiments in Buitenzorg which gave me a pleasant surprise was the clonal, or vegetative propagation of rice. Before I went to Java, I started the vegetative propagation of rice in this College with the object of using the pure lines, or clons produced in this way in the determination of the effect of environment on the length of beard of rice grains. Not having seen anything published on clonal propagation of rice, I supposed that we had the priority in this kind of work. Hence I was greatly surprised to find that, as in many other cases, the Buitenzorg Station was far ahead of us in this vegetative propagation work with rice. This points the truth of, "It pays to travel". If I remember correctly, the Buitenzorg work has been in progress for three years. The Java work has demonstrated conclusively that it is possible to establish pure lines of

rice through vegetative multiplication. This was the result I anticipated when I started the work in this College.

A few other things that I observed about rice that should be of interest to Filipinos have to do with irrigation and different systems of spacing and hilling. One interesting thing is the narrowness of the paddy dikes in Java. Though narrow, compared with those in the Philippines, I saw laborers cutting the dikes with ordinary grub hoes, apparently to clean them so as to use as much as possible of the surface of the dikes for planting purposes without danger of breaking them. True, in Java land is limited in relation to population, but this practice might well serve as a model for many of the Filipino farmers, much of whose land under cultivation is wasted in the form of dikes and vacant weedy partitions.

It was my impression, at least before I went on my trip, that the engineers of the Bureau of Public Works who are in charge of the construction of rice irrigation systems in the Philippines, figured on a six-inch application of water, following the practice in California and possibly in India. I recall, also, that the Plant Industry Division of the Bureau of Agriculture was to carry out careful experiments to find out the proper amount of water to apply before adopting the six-inch practice. In Buitenzorg, I was shown that the water applied is only about 2 centimeters deep and that a higher level is considered not only wasteful but detrimental in a physiological way to the rice plant. Mr. Koch's view is, if I remember correctly, that rice leaves under water which has the temperature that the water has in Java do not get the necessary amount of oxygen for the proper growth of the plant, and that if in other regions a higher water level in the field does not injure the plant, it may be because the water is not heated to the point where the water will lack oxygen as happens under Javan conditions. Mr. Koch is of the opinion that the Philippines would require less than six inches of water. Whether six inches or more of water will prove the amount needed on account of soil conditions peculiar to the Philippines and the prevalence of weeds in Philippine paddies, something not found in Java, remains to be seen. In any event my conviction is strengthened that there is need of co-ordination of work between the Bureau of Public Works, Bureau of Agriculture, and College of Agriculture in the matter of irrigation. Furthermore, the Philippine Government should send abroad for investigation of irrigation conditions for rice not only engineers, but also men trained in the agronomy side of rice production. If an agronomist accompanies the engineer, the country will receive greater benefit from the results of the investigation than if it is made by an engineer alone.

In the matter of distancing rice hills in the field and hilling, practically the same problem that confronts us here in the Philippines faces the Java Station for annual crops. The problem is to determine the optimum distance at which rice hills should be set and also the best number of plants to have in a hill. It seems it is realized in both countries that too much rice seed is sown for a given area of field to give the best yield. This is perhaps more common in the Philippines than in Java. In our country, judging from the results of the work of Rodrigo[7], it is entirely possible that wider planting would prove a more profitable

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7 Rodrigo, Pedro A. The effect of spacing on tillering and production of three varieties of rice. Philippine Agriculturist 13: 5-28. 1924.

practice. Also the thinner the planting is made, the easier will it be to practice mass-selection of seed in the field. The ideal condition of planting for mass-selection work will be when only one plant is set in each hill. The work of Mr. Montemayor of our Division of Plant Breeding has resulted in showing that seeds mass-selected from a field planted one-plant-to-the-hill yielded more than seeds selected from a field planted in the ordinary way, that is with one or more plants in each hill. In the light of the results which the Buitenzorg Station has so far obtained, we are probably using in the Philippines about twice as much seed as is necessary. Considering that an enormous amount of rice is used yearly for seed purposes and that much of this rice might take the place of part of the rice imported annually from Indo-China, Siam, and other countries, the discovery of the optimum distancing and hilling of rice plants in Philippine fields should, to my mind, be one of the foremost questions that our local agronomists should consider.

The Station for Annual Crops was kind enough to give me seed samples of the following varieties of rice for multiplication and tests in this College: Gadi Carolina, Gadi Solo, Gadi Back, Gadi Oewen, Gadi Oerang Oerangan, Tjereh Beuning, Tjereh Cebang, Tjereh Leniar, Tjereh Molok, Gadi Gandan, Tjereh Soelandjana, Tjereh Melati, Gadi Glindoeran, Gadi Rogol, Tjereh Temas, Gadi Gedangan, Gadi Djalen and Tjereh Skrivimankoti.

CORN AND IMPORTANT ROOT CROPS

The most important variety of maize in Java is a yellow flint corn, in many respects like the Native Yellow Flint of the Philippines, but a somewhat smaller and decidedly much harder corn. The Javan name for this variety is Gele Menado. In Madoera, the variety is also a yellow flint but the ear is very small, only about 10.0 cm. long and 2.5 cm. in the greatest diameter. This variety, I was informed, matures in about two months time. The preference in Java is for a hard corn as it is used as a substitute for rice as the Cebu corn is in Cebu and the Ilagan corn in Isabela, Philippines. The Javan corn variety is not to be considered as a standard purified variety but rather one that is genetically impure. By continued ear-to-row selection, the Buitenzorg Station has obtained a set of ears which look very uniform. In the fields between Batavia and Buitenzorg, I saw upland rice interplanted with corn, a practice which is common in some regions of the Philippines. Corn is also grown with cassava in some fields. The effect of a previous green manure crop, which was plowed under, on two successive corn plantings has been pretty thoroughly tested. The effect of the green manure plant, *Mimosa invisa*, was found in a test to result in an average increase of 6.5 ± 0.7 kg. of dry maize seed compared with the effect of a previous crop of sorghum in a plot 56.18 sq. m. in area; *Crotalaria anagyroides*, 6.5 ± 0.8. kg. and *Crotalaria usaramoensis*, 6.1 ± 0.6 kg. This was on the first planting. On a second planting, the effects were in the form of increases of 1.8 ± 0.7 kg., 1.2 ± 0.6 kg, and 1.8 ± 0.8 kg, respectively for *M. invisa*, *C. anagyroides* and *C. usaramoensis*. The variety of corn used was Gele Menado.

Similar experiments were carried out to determine the effect of these green manures on sweet potato and cassava, and as with corn, favorable results were obtained. I was shown two plots of cassava, one of which had green manure and the other without, and I saw an enormous difference in vegetative growth in favor of the plot with green manure.

Cassava is one of the most important crops of the Dutch East Indies and certainly the foremost root crop. It would surprise any Filipino or any one else not familiar with the importance of cassava and sweet potato in Java to find the many and varied experiments which have been undertaken by the Station for Annual Crops in Buitenzorg for the purpose of improving the hereditary qualities of these plants as well as their cultivation. Probably nowhere in the Tropics have so many foreign and native varieties of cassava and sweet potato been assembled, acclimatized, tested, subjected to selection and then used in breeding and other operations. Long before we started the production and test of seedling cassavas and sweet potatoes in this College, Buitenzorg had grown them by the thousands, as a result of which they now have a number of superior seedling varieties of these two root crops. I would like to acknowledge at this point the kindness of Doctor Cramer in sending me tuber-roots of his four or five best sweet potato seedling varieties. This is only one of the many instances in which the College has materially profited from the work being done in Java.

SOME NOTES ON JAVANESE FRUITS

The fruit flora of Java must be very similar to that of Mindanao. The fruit markets in Batavia, Weltevreden, and Buitenzorg show this to be true at least so far as the common fruits of Mindanao and Java are concerned. At the time of my visit the following fruits could be bought in quantity wherever fruits were sold: banana of several varieties, the so called Buitenzorg pineapple, the *chico*, or sapodilla (*Achras sapota* L.), the *bulala* (*Nephelium mutabile*), and another species of the same genus (probably *N. lappaceum*), the jakfruit, mangosteen, the *salak* (*Zalacca edulis*), *gandaria* (*Bouea macrophylla*), *durian* (*Durio zibethinus*), *papaya*, *duku* (*Lansium domesticum*, var. *duku*), *bauno* (*Mangifera caesia*), *huani* mango (*Mangifera odorata*), the soursop (*Anona muricata*), *makopa* (*Eugenia javanica*), the carambola (*Averrhoa carambola*), the *hevi* (*Spondias cythereae*), and a variety of mandarin. Besides these there were others, I am sure, which I failed to notice or which are not familiar to me.

There are at least three varieties of banana common in the markets in Java; these are called in Malay, *pisang radja*, *pisang mas*, and *pisang lempeneng*. The favorite table variety is one the fruit of which tastes like the Saba of the Philippines but the skin is like that of the Bungulan. The Buitenzorg pineapple is well known in Java for its high degree of sweetness and its relative freedom from fiber. The fruit is smaller than our Red Spanish variety; its "eyes" are prominent and the leaves are spiny. In many of the fruit characteristics, it is quite similar to the Queen variety. I was so much impressed with the Java pineapple for breeding purposes in this College that I brought back with me a number of crowns for propagation purposes. The Java chico is an interesting fruit. Although its Malay name, *sawoc manila*, suggests Philippine origin, it does not approach, in its most distinguishing characteristics, the Philippine sapodillas. It is supposed to have been introduced into Java from Central America. The largest fruit may reach a length of seven centimeters. Its most important qualities are that it has very few seeds, usually only one, sometimes two or three, and is very juicy. The chico trees I saw appeared to me to be generally taller and to have less compact crowns than those in Los Baños. It appeared to be the practice of some chico owners to bag bunches of fruits on the tree. The Java Nepheliums, *N. lap-*

paceum and *N. mutabile*, are not any better than our *rambutan* and *bulala*. The same may be said in regard to jakfruit and mangosteen. The *salak* (*Zalacca edulis*) is more common in Java than in the Philippines. In fact it has not even reached our markets and is little known. Of course this fruit does not have much to make it popular. Its skin is scaly and dark brown; the flesh is white, brittle and tastes like immature *dulian*. The fruit is about 5.8 cm. long and 6.0 cm. in greatest diameter. Another fruit which is common in the markets of Batavia and Buitenzorg but hardly known in the Philippines is the *gandaria* (*Bouea macrophylla*). The Java lanzon (duku), papaya, carambola, and mandarin are inferior to those found in the Philippines. It is my conviction that both countries would profit a good deal by an exchange of their best fruit varieties, an exchange which has been going on for a good while. I was able to bring back with me propagating material of most of the fruits I mention in this report. These have been planted in the Plant Breeding Garden of this College for further use.

A GOOD METHOD OF STORING CORN SEED

When I entered the seed house of the Station for Annual Crops, the thing that engaged my attention at once was the absence of seed weevils in the building. I do not recall seeing any sign of their presence. In this College we have always been confronted with the problem of how to store seeds of annual crops,—of maize especially, in a proper way and without its being attacked by weevils or the Angumois moth,—so I was naturally eager to learn the method of seed storing used by Mr. Koch. He explained the method as follows: The maize seed to be stored is dried to constant weight in the sun,—in the case of his work, on cement floors. That the seed has been reduced to constant weight is determined by taking a sample of the seed, say 1000 grams, and determining the weight of this every day. When constant weight is reached, which happens in about a week's time, the seed is placed at once in dry, sun-heated empty petroleum cans, whose tops have not been removed. These are then closed hermetically tight by plugging the hole in the top of the can with caoutchouc or stoppering it with an ordinary cork and then pouring melted paraffin over it. Corn seed kept in this way did not lose the vitality after a year or even 15½ months of storage, and was never attacked by weevils or moth. The same method was used for soy bean seed and the results were about the same.

AGRICULTURAL INSTRUCTION AND EXTENSION

As far as I could learn this College gives a broader course in Genetics than does the Agricultural School (Middelbare Landbouwschool) in Buitenzorg. The Genetics text book used in Java is one entitled, "Beginselen der Selectie" (Principles of Breeding), the contents of which are grouped under the following headings: (I) Variability and Heredity, (II) Hybridization, and (III) Selection. The book was written by Dr. Th. Valeton Jr. and published by Drukkerijen Ruygrok & Co., Batavia, Java. The book contains little or nothing on such important topics as mutation, acquired characters, eugenics, and other important genetic phases.

The Dutch Government in Java complains of the same general difficulties with which our Bureau of Agriculture and College of Agriculture in the Philippines are faced in their agricultural extension work. It appears that the Javanese farmers are generally unappreciative of, if not entirely antagonistic to, the

extension efforts of the government to improve Javanese agriculture. The Filipino farmers are generally less illiterate than are their Javanese brothers and hence our difficulties in extension work are not so great as in Java. In both countries the farmers do not seem to have much confidence in the extension agents who are graduates of agricultural institutions. In both countries, also, this is due to the lack of proper training, experience, and tact of the agents. The Department of Agriculture in Java has therefore found it necessary to inaugurate an improvement in the extension system. Now, those who desire employment as extension agents are required after graduation in the Agricultural School, to undergo a more intensive training in the different stations of the Department before they are sent out to do agricultural extension work among the people.

MARSILEA CRENATA PRESL., A NOXIOUS WEED: ITS ERADICATION AND CONTROL IN RICE FIELDS[1]

By EDUARDO QUISUMBING

Of the Department of Plant Physiology

WITH TWO PLATES

Although *Marsilea crenata* Presl. has been reported in taxonomic accounts as occurring in various habitats, nothing has been written regarding its economic importance. It is present in paddy fields, but the farmers make no attempt to eradicate it. They either do not know that its presence in the rice fields reduces the yield of grain or they are indifferent to the loss. This paper deals with the ecology of this weed, and gives methods for its eradication and control.

Blanco (1) was the first to record this species. This was in 1837 and he mentioned it again in 1845 (2). The identity of this species has been investigated very thoroughly by Merrill (3).

DESCRIPTION OF THE PLANT

The synonyms of *Marsilea crenata* Presl. are: *Marsilea mearnsii* Christ; *Marsilea menuda* Blanco; *Marsilea trifolia* Blanco. In the Philippines in the Tagalog dialect it is known as Kaya-kayapuan and banig-usa.

The plant is low, creeping, and slender, with marked nodes and internodes. At each node, a single leaf is borne. At the axil of the node and the leaf, runners are produced (see Plate II, fig. 1). Each leaf has a long erect petiole (stipe), somewhat pubescent, with a compound lamina of two pairs of leaflets. Blanco (1) reported an abnormal form of *Marsilea*, with three, rather than four, leaflets, and called it *Marsilea trifolia*. The author after examining many thousands of normal specimens, both living and preserved, could not find any having such abnormality. Dwarfed plants, however, exhibit some aberrations described by Blanco, but they occur rarely. Out of many thousands of living plants examined this year (1924), there occurred only three cases of abnormality; one with two leaflets (Plate II, fig. 16); one with three leaflets (Plate II, fig. 17); and one with four leaflets, the basal two being smaller and degenerated (Plate II, fig. 18). As in the Filicales, the young leaves are circinate and pubescent. The size of the leaflets varies according to the habitat in which the plant grows. Some are 3×2 mm., others growing in wet places are 22×18 mm. The surface is glabrous, with distinct venation. The margin of the leaflets vary; some are entire while others are wavy (Plate II, figs. 2-15). The length of the petiole, as the size of the leaflets, is variable; these characters depend upon the medium in which the plant grows. When the plant grows in water the length of the petiole may attain a length of 25 cm. This long petiole is an adaptation of the plant so that the lamina will not be submerged. Dwarfing, when petioles measure only 5 mm. in length, takes place when the plants grow under xerophytic conditions. The length of the internodes also depends upon the water relation. When rice paddies are flooded, runners seem to become active vegetatively and the internodes

[1] Experiment Station contribution No. 244.

become elongated, but when the fields are allowed to dry, the runners diminish in length. Runners are pubescent and may attain the length of one meter and an average of 50 cm. in good wet soil. The root system becomes well developed when there is plenty of water in the soil, but it is limited in dry places.

THE SPOROCARPS

DESCRIPTION

The sporocarps (spore-fruits) (Plate II, fig. 1) are borne in groups, usually 3, occasionally 4, 5 or 7, at the nodes attached near the base of the petiole by a pedicel. When the growth of the secondary runners are suppressed, the number of sporocarps are increased. The stalks of the sporocarps are 4-7 mm. long; the common length being 6-7 mm. The sizes of the sporocarps also vary; those produced by the dwarfs are 2×3 mm., while those formed when the water in the soil is abundant are 3×4 mm. The sporocarps are light green in color and very pubescent when young, but when mature, they turn dark brown. They are bean-shaped and numerous sori are enclosed. The sori contain both the macrosporangia and microsporangia. The coat is shiny and hard.

GERMINATION

The sporocarps never germinate in a dry situation. Germination takes place only in water or under very wet conditions. The sporocarps remain viable for one year or more after being buried in the dry soil. Because of a mucilaginous substance within, they are so tenacious of life that they germinate perfectly after a rest period of several years. Chamberlain (4) states that sporocarps from sublimated herbarium material fifty years old germinated readily.

To secure a rapid germination of the sporocarps, a portion of the hard wall is cut away and they are placed in a dish of water. The absorption of the water by the mucilaginous tissue forces the two halves of the sporocarps apart. As the water is absorbed, the gelatinous mass continues to expand and elongate, thereby forming a ring (see Plate II, fig. 19). In *Marsilea vestita* (5) the sori containing macrosporangia and microsporangia become attached to the ring, while in *Marsilea crenata* the indusium becomes completely dissolved and the macrospores and microspores are set free. Embryos are abundant after 24 hours, and young green plantlets with roots develop in two days.

DISTRIBUTION

The species is of wide distribution in the Philippines. It has been reported from Manila; Pasig, and Caloocan, Rizal Province; along the banks of the Lamao River, Bataan Province; Banco, Bontoc; Batangas Province; in Laguna Province, in Los Baños in mudholes, and in Calamba in rice paddies; Irosin, Sorsogon Province; Legaspi, Albay Province. It grows in open waste places, in rice paddies, in shallow pools and mudholes, being more abundant near the edges.

Marsilea plants can be grown without difficulty in the green house, and also in flats and can be made to produce sporocarps at any time.

DISSEMINATION

The dissemination in rice paddies is accomplished by means of irrigation water and by birds which feed in the rice fields carrying on their feet mud in which occur sporocarps. The sporocarps are dropped in other fields visited by

birds. Carabaos, dogs, and other animals also, may carry these sporocarps on their feet.

The occurrence of *Marsilea* in mudholes and in wet waste places is due to several causes. Birds and rain water play important rôles. *Marsilea* in mudholes remains there until the dry season. It grows luxuriantly when the soil is wet and when it rains, but at the approach of the dry season the plants stop reproducing vegetatively and instead produce sporocarps. When the ground becomes dry, the sporocarps ripen and dry up, remaining in this condition during the dry season. When the rainy season comes with floods, the sporocarps are transported to other places. This explains why the plants can not be located in the same spot in successive years. If no flood occurs, the plant remains in the same place, becoming more vigorous and pernicious the following year.

METHODS OF EXTERMINATION

This weed can be exterminated and controlled by proper methods of cultivation. If the plants are not numerous they can be pulled up and burned. But if the plants cover large areas, especially in paddy fields, thorough cultivation will remove them.

Marsilea plants were discovered by the author on October 10, 1923, in rice fields in Calamba, Laguna Province, after the rice was harvested. They multiply so rapidly that in a week the paddies were completely matted and sporocarps were formed (Plate I, figs. 1-2). As plowing and harrowing would be ineffective at this stage, the paddies were flooded. This method discouraged sporocarp formation and checked further vegetative growth as the plants were submerged in water to 35 centimeters in depth for two weeks. Long petioles and runners were produced, but the leaves soon became yellow and rotted. After submerging the plants two weeks, the water was rapidly drained off and the fields immediately plowed. The day following the plowing the fields were harrowed three times. The *Marsilea* plants which became covered with mud in the harrowing were piled up and allowed to dry and then burned. As no new plants appeared at the end of two weeks, the fields were prepared for rice. After the rice was planted, up to harvest time, frequent visits were made to these paddies but there was no appearance of this weed. A month after the harvest of the dry season crop (May 10, 1924) a few scattered plants were found. Pulling up these few plants was all that was necessary to completely free these paddies from this noxious weed.

Flooding and submerging experiments were tried on the College Campus and in Calamba, without cultural methods, but results were not satisfactory. It was found that the plants could remain submerged for several months without being killed. The dying leaves were immediately replaced by new leaves.

Mr. Batanes, the farmer in charge of the field infested by this weed, reported that the yield in grain of his field was reduced to one-third. This, we attribute to the presence of this weed. A year before the spontaneous appearance of the weed, the average yield was 30 cavans to a cavan (43 kg.) of seed. The yield when the weed was present was only about 10 cavans. The harvest following the eradication of the weed gave about 20 cavans, a return to normalcy.

SUMMARY

1. *Marsilea crenata* Presl. if allowed to grow wild in a rice field may reduce the yield of rice.

2. For the complete eradication of this weed in rice fields, the production of sporocarps must be prevented and the vegetative growth discouraged.

3. *Marsilea* can be exterminated and controlled by proper cultural methods. Plowing and repeated harrowings of the field have been found very satisfactory.

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ILLUSTRATIONS

Plate I

Fig. 1. A paddy field after harvest, infested by *Marsilea crenata* Presl.
2. A close view of a portion of the same field.

Plate II

Fig. 1. Plant (*Marsilea crenata* Presl.) showing a primary runner, the sporocarps, and buds of the secondary runners. (X 1/3)
2-15. Leaflets showing morphological variations. (X1)
16. A leaf with two leaflets. (X2)
17. A leaf with three leaflets. (X2)
18. A leaf with four leaflets, the basal two being smaller and degenerated. (X2)
19. A germinating sporocarp (sp) showing gelatinous ring (g) with macrospores (ma) and microspores (mi) free. (X2) Diagrammatic.

Fig. 1.
A paddy field infested by a noxious weed (*Marsilea crenata* Presl.,) after the rice was harvested.

Fig. 2.
A close view of a portion of the same field.

PLATE I

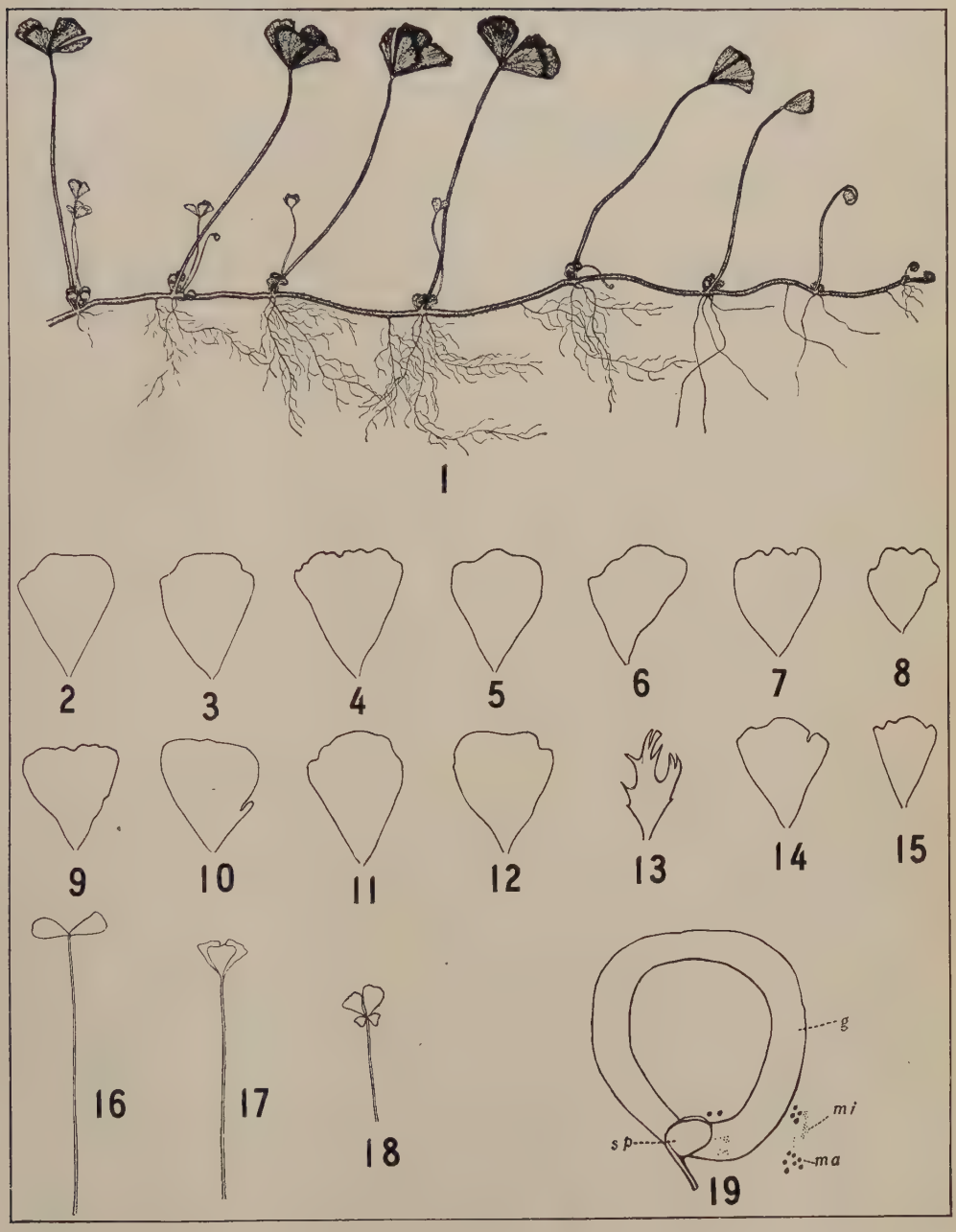

PLATE II

NOTE ON DIOSCOREA HISPIDA DENNST AS A CURE FOR MYIASIS[1]

By Miguel Manresa

Of the College of Veterinary Science

Dioscorea hispida Dennst (*Dioscorea daemona* Roxb), known in the vernacular as *namí* (Tagalog), *cayos*, or *cuyut* (Visayan), *korót* (Ilocano), and *kalot* (Pangasinan and Pampanga) is a common plant in the Philippines. It is a tuberous vine which thrives without care on wooded land and under favorable conditions produces a root of enormous size. The toxic properties of the root of this vine are fairly well known. Guerrero, De la Paz, and Guerrero (1) record it among the Philippine plants which have caused intentional and accidental poisoning. Writing about the Mangyans of Mindoro, Miller (2) says that when food fails or runs low these people resort to the roots of *namí*. When properly prepared it is a farinaceous food and is quite generally relished even by the Christian Filipinos.

It is not the toxic properties of *Dioscorea hispida*, however, nor its value as food that makes it so popular among the live stock owners. It seems to be quite generally used in many parts of the Philippines as an anti-myiasis agent for killing maggots infesting wounds in animals. After peeling a large root and slicing it into thin pieces, it is triturated in a mortar. When the mass assumes the consistency of a paste it is ready for application, either alone or in combination with coconut oil and some leaves, such as tobacco, *talong-punay* (*Datura alba* Nees) or the fruit of chile pepper (*Capsicum frutescens* L). In the vicinity of Los Baños, Laguna; Polo, Bulacan; and Tarlac, Tarlac, the root is used in combination with lime. On a stock farm remote from a town the writer saw *namí* used in a severe case of myiasis of the scrotum in a carabao following faulty castration. The caretaker literally filled the hole, which contained necrotic tissues and maggots, with the finely crushed root of fresh *namí* and attempted retention by improvised sutures. Then he let the animal loose; in the course of two days the enormous swelling had subsided. The animal was caught and a thorough examination of the wound revealed the fact that all maggots had been killed.

Dr. Leon Ma. Guerrero, of the Bureau of Science, who is in charge of the investigations of medicinal and poisonous plants, reports that *Dioscorea hispida* contains two alkaloids. One of these is fixed and known as dioscorin; it is highly poisonous, one centigram being sufficient to kill a horse. The other, known as dioscorein, is volatile and relatively less toxic. The plant is not listed in Pammel's "Manual of Poisonous Plants"; and so far as the writer knows nothing has been written regarding its medicinal properties. In view of the wide distribution of this plant in the Philippines and of its apparent efficacy in the treatment of myiasis which is a frequent and often serious affection of animals on stock farms, the writer believes that the subject is of sufficient importance to warrant the undertaking of a series of experiments upon the tuber for the purpose of confirming or refuting the results so favorably reported from the field. It might be possible also to devise a better means of applying the remedy.

[1] Experiment Station contribution, No. 245.

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NOTE: CAUSE OF FOOT-AND-MOUTH DISEASE DISCOVERED

Another important milestone was placed on the road of progress of veterinary science when the announcement of the discovery of the cause of foot-and-mouth disease was made on April 7, 1924. The *Journal for the American Veterinary Medical Association* states that the announcement was made by the director of the Hygienic Institute of the Veterinary High School of Berlin, Privy Councillor Doctor Frosch, the Division Chief of the Institute, and Privy Councillor Doctor Dahmen before the Microbiological Association of Berlin and many other guests. The Veterinary Division of the Department of Agriculture of Germany was also represented by the Assistant Secretary Ramm, together with his staff; likewise the entire faculty of the Veterinary High School of Berlin led by the Dean was present on that occasion.

The microorganism has been called the Frosch-Dahmen bacillus in honor of its discoverers. Quoting from the *Journal*: "According to the statement of Doctor Frosch the discovery was made possible with the aid of the Kohler apparatus constructed by Zeiss which has already rendered such splendid service in the discovery of the cause of contagious pleuro-pneumonia. With short-wave ultra-violet rays of this apparatus, it is possible through photographic reproduction even at the highest magnifications to demonstrate the minutest particles and reproduce them in photograms which could not be attained by ordinary microscopical investigations."

The Kohler apparatus is a new and very complicated machine which entails tremendous work in its operation, necessitating many hundreds of photographs before a proper focus is obtained.

The Frosch-Dahmen bacillus has also been cultured in artificial media by Doctor Frosch and the disease reproduced in laboratory animals.

The scientific world awaits with keen interest the publication of this important discovery. It is hoped that by the use of the Kohler apparatus it will be possible to discover such ultramicroscopic microorganims as those of rinderpest, hog cholera, scarlet fever, measles, etc.

A. K. Gomez,
Of the College of Veterinary Science.

REVIEW: "ORIENTAL VERNACULAR NAMES OF THE GENUS DIOSCOREA"[1, 2]

This modest title covers an extremely important work by Doctor Burkill on the vernacular nomenclature of the important economic genus Dioscorea in the Orient. It is the outcome of years of study and collection of data from all possible sources. The difficulties of such a work are considerable because of the great differences of spelling in the original sources. Dutch, Portuguese, French, English and other European systems of spelling as well as the local variations of names borrowed from other languages have caused considerable confusion, and in this paper such cases have been included and where possible explained. This is a good point in the paper. The names are listed as they are used, not as they might have been had the natural mistakes of diction in their passage from one tongue to another not been committed.

The author has produced some semblance of order in what seems at first sight a tremendous collection of unrelated names. In a short review such as this it is impossible to give more than an indication of the nature of the work, but the word "ubi" may be considered as an example. The name is used in the Philippines for *Dioscorea alata*. In Madagascar it is found as "ovi" and in Tahiti as "ofi". It is considered that the word passed from its Malayan point of origin to Madagascar by way of Ceylon and Southern India, but in these latter countries it has died out. It has been suggested that the word was originally prefixed by an aspirate, it being found as "hubi" amongst the Sakais, a negrito people of Malaya, and in Java where it is "huwi" in Sundanese. In eastern Malaysia the name "wi" appears; in the Aru Islands and New Guinea "wiwi" and "wiwiwak"; and the suggestion is made that "wintog" and "winto" for *D. laurifolia* in the Northern Celebes and "wika" for *D. bulbifera* on the Morshead River in Queensland may have some connection.

It is of interest to note that the common poisonous Philippine species *D. hispida* (*namé*) is effective as a tiger poison.

This work opens up a tremendous field for similar work here in the Philippines. Our knowledge of the vernacular names of native plants even in the Tagalog provinces is very fragmentary indeed, and practically nothing has been done on the correlation of the names that we do know. Botanists in the tropics too often overlook such opportunities for pioneering work of real value, and devote their energy to problems on which armies of workers in the temperate zones are already working.

—*Reviewed by* D. A. Herbert,
Of the Department of Plant Physiology.

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[1] General Contribution from the College of Agriculture No. 118.

[2] A list of oriental vernacular names of the genus Dioscorea, Burkill, I. H. The Gardens' Bulletin, Straits Settlements, III, Nos. 4-6: 244 pp., 1924.

ABSTRACTS[1]

Comparative study of milk, snail, and copra meal as supplement feeds for growing chickens. Tomas Ferrer. (*Thesis presented for graduation from the College of Agriculture No. 190. Experiment Station contribution, No. 246*).—In this experiment milk, snail, and copra meal were used as supplement feeds to the basal ration of a mash mixture of equal parts by weight of ground corn, ground soy bean or cracked mungo, ground palay, and rice bran. The experiment was run in three sets, each consisting of three breeds of chickens, Barred Plymouth Rock, Cantonese, and Native. Each set was separated into two lots so that the first set was divided into milk and copra meal-fed lots; the second, into milk and snail-fed lots; and the third, into copra meal and snail-fed lots.

That milk was better than either copra meal or snail as supplement feed for growing chicks was shown in the first and second sets of this experiment where it was found that the milk-fed chicks had an average weekly increase of 10.52 grams over the copra meal-fed chicks, and 11.43 grams over the snail-fed chicks. Copra meal-fed chicks gave an average weekly increase in weight of 5.01 grams more than the snail-fed.

The milk-fed chicks had a lower mortality than either the copra meal-fed or snail-fed and the snail-fed chicks had a much lower mortality than copra meal-fed.

—*Abstract by Benedicto C. de las Alas.*

Multiplication test of F_3 selected strains of upland rice. Catalino S. Rayos. (*Thesis presented for graduation from the College of Agriculture, No. 191; Experiment Station contribution, No. 247.*).—In some countries, such as Japan, Java, and Cochin-China, rice seed selection has been made with very successful results.

The author conducted a very interesting study of pedigree culture of upland rice of different varieties and strains belonging to the third generation with a view of isolating pure and improved seeds for future distribution among the Filipino upland rice farmers. The work dealt mostly with the multiplication test of the selected strains of rice, obtained the previous years. He found that selected seeds gave a much higher yield per unit area than non-selected seeds of the same variety.

—*Abstract by Thongdee Resanont.*

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[1]Abstracts prepared as part of the required theme work in English 101, College of Agriculture.

EXCHANGE NOTES

Another instance of the practical application of the work of the Bureau of Chemistry to agriculture, the relation of which is sometimes more or less vague to the layman, is to be noted in the recent accomplishment of H. C. Gore, a chemist in the department who has been working on methods for the more economical utilization of farm crops. The instance referred to is the development of a chemical process of making sugar from the corn grain * * * It is expected that in time the making of maltose sugar from corn will play an important part in the utilization of that crop.

—*The Official Record,* U. S. Department of Agriculture.

Freshman, what are you going to do after graduation? * * * One should choose his life work. Analyze yourself and determine those subjects you do the best in. Then look over the field of jobs for graduates and determine what sciences are most used in each work. Next, determine which one of these jobs most closely fulfills your requirements. If this is done carefully and with thought the field will be narrowed to four or five positions. Last of all, what would you like to do?

—The *Agricultural Student,* College of Agriculture, Ohio.

It is well to recognize that a competent agricultural expert cannot be efficiently trained in a laboratory adapted for that specialty; his business constitutes a profession not a trade and like all professions demands a wide basal training on which the specialized studies may be built. The broad nature of this training necessitates application to study of a large number of cognate subjects and hence a prolonged course. It may be possible to turn out a certain type of plant pathologist and a type of agricultural chemist or entomologist by a more or less restricted laboratory training; but the usefulness of such a man, although great, is distinctly limited when the broad agricultural aspects of his specialty call for consideration. * * *

For example, the plant pathologist requires a thorough training in plant breeding and horticulture if he is to be equipped for more than the mere diagnosis of the nature and cause of a disease, and is to inspire confidence in the agriculturalist who is more concerned that the pathologist should find a cure. Modern plant pathology is learning to place more and more reliance on plant breeding and genetics, for it would appear that in this direction lies the most promising field for the discovery of the cure for many mystic plant diseases. No plant pathologist could be regarded as well equipped for his agricultural research did he not possess some sound knowledge of entomology, soils and principles of agriculture. It is further necessary that he should have sound training in the basal sciences during the preliminary years * * * What has been said about plant pathology concerns equally well such subjects as economic entomology and agricultural chemistry.

—The *Australian Sugar Journal.*

The announcement that the Royal Society for the The Prevention of Cruelty to Animals proposes to build a $10,000 cenotaph in Hyde Park (London) to the memory of birds, beasts, and fishes which died in the service of Great Britain during the war has been received with astonishment and criticism. It was explained that the fishes were the gold-fish which were used for testing water in which gas helmets were washed before being reissued.

—*Zoological Society Bulletin* from the *Sun*, New York.

Burma is essentially a producer of raw materials, both agricultural and mineral, and obtains its manufactured goods from the world's markets. The economic welfare of the people depends largely upon agriculture, and 80 per cent of this industry is in the hands of the Burmese * * * Rice is Burma's staple product. The crop covers practically 71 per cent of the entire cultivated area, and almost 75 per cent of the Province's 13,500,000 people are engaged in its cultivation, milling, and transportation. The annual production approximates 6,000,000 tons, with an exportable surplus of 2,250,000 tons of cleaned rice—40 per cent of the world's entire surplus of rice. * * *

Wheat and other food grains, raw cotton, hides, and oilseeds are also produced in exportable quantities, and approximately 60,000 acres are planted to rubber. The Province is also becoming aware of other potential resources.

—*Commerce Reports* U. S. Department of Commerce.

Bird censuses will again be taken on selected areas throughout the United States this summer (1924), under supervision of the Biological Survey of the United States Department of Agriculture. The purpose is to furnish information as to the exact number of birds nesting within the boundaries of selected tracts.

—*Zoological Society Bulletin.*

In the college greenhouses (Kansas State Agricultural College) experimenting in coloring flowers of different kinds in full bloom has been in progress for two or three years and this year a considerable number of orders have come in for the experimental product.

The process of coloring flowers is a comparatively simple one, consisting in dissolving the dye to be used in water, and placing the stems of the freshly cut blooms therein, to remain for about 24 hours. The dye is similar to that used in ordinary coloring of fabrics.

—The *Kansas Industrialist.*

It may not be generally recognized that slow development in size means early maturity, and the latter in turn spells an undue number of small to medium size in eggs. Poultry-farmers are slowly learning the lesson that the pullets that lay at 4½ months are the root of the small egg trouble. Most of this is preventable.

—The *Agricultural Gazette* of N. S. W.

COLLEGE AND ALUMNI NOTES

The Unit IV (College of Agriculture and Forest School) Basket Ball team opened the Intercollegiate Tournament on August 2 in General Luna Hall, Manila, by defeating College of Education team with a 38 to 10 score. Dionisio Calvo, Captain, Florencio Soliven, Gonzalo Salazar, Regino Fernandez, and Andres Lemos composed the winning team. In the second half of the play practically the entire second team entered for the "Aggies' " goal.

Followers of University sports will recall that Unit IV has a basket ball record of ten consecutive University championships and numerous memberships in Far Eastern Olympics. This first winning step on the eleventh consecutive championship is recorded with justifiable pride.

The prizes for securing the largest number of members in the summer Y. M. C. A. membership drive were distributed at the College "Y" on the evening of August 9. An entertaining program was given in honor of the occasion. The address of the evening was by Hon. Rafael Palma, Acting President of the University of the Philippines. The President's theme was the need of intelligent farmers and the advantages the occupation offers. The address was simple and direct in its appeal. Mr. Adolfo, the "Y" Secretary in charge, gave a fine exhibition Indian club drill. Mr. Ireneo Sevilla furnished amusement with George Cohen's "Discourse on the Ladies". Singing made up a goodly part of the program. Mrs. D. A. Herbert and Mrs. A. W. Adolfo sang Tosti's beautiful "Venetian Song". The Y. M. C. A. Glee Club, under the direction of Mrs. Adolfo, opened the program with "My Bonnie Lies over the Ocean" and "The Laugh Provoker", and closed it with the jolly songs, "There was a Man" and "Johnny Smoker".

A fine concrete gate at the entrance to the Animal Husbandry grounds is being erected by the department. This completes a system of fencing designed to protect the College herd from infection from the lower regions of Los Baños, which are often visited by serious epizootics. The Ranchers' Club is contributing to the arch of the gate. Mr. Arana, College Engineer, is responsible for the design and the construction. Dignity is added to the Animal Husbandry grounds by this artistic entrance and it marks another forward move in Campus Beautiful as well as Useful.

The College can boast now of an adequate animal equipment for instruction. The latest inventory of College animals is as follows:

Horses	8	head
Cattle	77	"
Carabaos (and buffaloes)	31	"
Swine	128	"
Sheep	9	"
Goats	24	"
Poultry	510	"

In addition to native, foreign bloods are represented in the collection, such as Arabian horses, Nellore, and Hereford cattle, Indian buffalo, Indian sheep and goats, and various imported breeds of swine and poultry.

A fire broke out at the College hog barn in the night of July 23, charring and destroying almost completely the whole structure. The swine herdsman had enough presence of mind to turn out all the animals, so no serious loss occurred with the live stock. The fire originated from a short circuit in the electric wiring.

Mr. Pablo Mabbun resigned his position as graduate assistant in rural economics to accept, at a large advance in salary, a position as instructor in the Cagayan Provincial High School at Tuguegerao.

Mr. Ricardo Avila resigned his position as instructor in history to accept a position in the Ilocos Sur Provincial High School at Vigan.

Alex. Gordon, B. S. A. '24, Government pensionado appointed from the Governor General's office, sailed on *S. S. Jefferson*, August 15, for the United States. Mr. Gordon will go direct to the University of Nebraska where he will major in irrigation engineering.

On August 3, Gonzalo Merino, B. Agr. '14, for some years Chief of Pest Control, Bureau of Agriculture, recently appointed pensionado from Department of Agriculture and Natural Resources, sailed on the *S. S. Jackson* for the United States. Mr. Merino will study at Leland Stanford Jr. University, where he will specialize in entomology.

Announcement has been received that Isidoro Collado, B. Agr. '21, was graduated, April 17, from the Iliff School of Theology, Denver, Colorado, with the degree of Bachelor of Divinity.